

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Patent Application of

Z. Jason Geng

Application No.: 10/728,393

Filed: December 4, 2003

For: A System and a Method for High Speed
Three-Dimensional Imaging

Group Art Unit: 2622

Examiner: PETERSON, CHRISTOPHER

Confirmation No.: 9234

REPLY BRIEF

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Commissioner for Patents
P.O. Box 1450
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Sir:

This is a Reply Brief under Rule 41.41 (37 C.F.R) in response to the Examiner's Answer of **September 13, 2010** (the "Examiner's Answer" or the "Answer"). In Section 10, the Answer contains a response to some of the arguments made in Appellant's brief. Appellant now responds to the Examiner's Answer as follows.

Status of Claims

The Examiner's Answer makes no change in the status of the claims.

Under the imposition of a previous Restriction Requirement, claim 1-31 and 40-59 were withdrawn from consideration. To expedite prosecution of this application, these claims have been cancelled without prejudice or disclaimer.

Further, in a previous office action, claims 37-39 and 60-64 were also alleged to be drawn to nonelected species according to the previous Restriction Requirement, and were therefore withdrawn. Of these claim, 60, 63, and 64 are an independent claim set and are not at issue in this appeal. Claims 37-39, 61, and 62 are still at issue due to their dependence on pending claims. Appellant will be entitled to rejoinder of any withdrawn dependent claims upon allowance of any corresponding independent claims. MPEP § 821.04.

Thus, claims 32-36, and 65-73 are currently pending in the application and stand finally rejected. Accordingly, Appellant appeals from the final rejection of claim 32-36, 61, 62, and 65-73.

Grounds of Rejection to be Reviewed on Appeal

The Answer makes no change to the Grounds of Rejection to be Reviewed on Appeal and maintains the following grounds of rejection.

(1) Claims 32-36, 61, 62, and 65-72 were all rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent App. Pub. No. 2003/0235335 to Yukhin et al. (“Yukhin”).

(2) Claim 73 was rejected under 35 U.S.C. § 103(a) over the combined teaching of Yukhin and U.S. Patent No. 5,014,121 to Hasegawa et al. (“Hasegawa”).

According, Appellant hereby requests review of each of these grounds of rejection in the present appeal.

Argument

(1) Claims 32-36, 61, 62, and 65-72 are patentable over Yukhin:

Claim 32:

Independent claim 32 recites:

A high speed 3D surface imaging camera comprising:
 a light projector for selectively illuminating an object, said light projector being configured to project ***three sequential light beam projections having different colors*** and different spatially varying intensity patterns from said projector onto said object; and
 an image sensor configured to receive reflected light from said object and to ***generate three separate color image data sets based on said three sequential, differently colored, variable intensity pattern light beam projections***, said three separate color image data sets providing said 3D image data of said object.

(Emphasis added)

In its Appeal Brief of June 24, 2010 (“Appeal Brief”), Appellant had argued that Yukhin does not teach or suggest that the claimed light projector of claim 32 is configured to project “three sequential light beam projections having different colors.” (Appeal Brief, p. 9). Therein, Appellant defined “color” as “the appearance of objects (or light sources) described in terms of ***a person’s perception of their hue and lightness (or brightness) and saturation.***”

(<http://www.onelook.com/?w=color&ls=a>).

In contrast to this, Yukhin teaches that:

Light sources 510A-510N may generate light beams. In at least one embodiment, one or more light source 510A-510N can ***generate light of a different spectral range***, for example, ***ranges of the ultraviolet, visible and infra – red spectra of electromagnetic radiation.***

(Yukhin, para. 0061) (emphasis added).

Therefore, Yukhin instead teaches using electromagnetic radiation from ***different*** spectral ranges, i.e., ultraviolet, visible and infra-red spectra. It is clear that claim 32 recites a projector

outputting light beam projections of three different *colors*, i.e., *three different wavelengths* within the *visible spectrum*. This is not taught in Yukhin, and for this reason alone, Yukhin cannot anticipate the claim 32 or its dependent claims.

The Examiner's Answer asserts that because Yukhin teaches that "light from *one to N spectral ranges* may be projected on object 560 from the exemplary illuminating unit,' that this means "the N spectral ranges (narrow band of wavelengths) can be *within* one of the three ranges (ultraviolet, visible and infra-red)." (Examiner's Answer, p. 14). However, this interpretation of Yukhin goes beyond the broadest reasonable interpretation of claim 32 because Yukhin does not suggest that the three different wavelengths are within one specific electromagnetic range. Indeed, Appellant interprets Yukhin to require that light from the illuminating unit come from each of those ranges recited, i.e. ultraviolet, visible and infra-red spectra.

Additionally, Yukhin never teaches or suggests a light projector that projects the light beams sequentially, i.e. "three sequential light beam projections having different colors." (Claim 32). Again, a "sequence" is "a following of one thing from another in time." (<http://www.onelook.com/?=sequence&ls=a>). It should be clear, therefore, that the light projector as claimed in claim 32 is configured to project three light projections of three different colors in sequence, i.e., one after another in time. The final Office Action of January 27, 2010, however, suggests that:

Yukhin teaches the control unit 402 may also control temporal functions, such as the length of time or frequency of the illumination. The Examiner analyzes the limitation of temporal functions to mean limited or length of time. Yukhin teaches the structured illumination from the N sources is projected by an optical system, e.g., an afocal optical system, on the object's surface, distorted by a

surface relief of the object and collected by the N photodetectors. The collected images are converted by corresponding electronic units to digital signals and preprocessed (Para 43). Yukhin teaches the signal processor 420 may control illumination unit 401 and detecting unit 405 via control units 402 and 406 (Para 56). Yukhin teaches the control unit 406 transmits timing and control signals to detecting unit 405. Detecting unit 405 may be positioned to receive primarily light transmitted from a neighboring illumination unit and reflected from the surface of an object in the area or transmitted from an opposing illumination unit and passing through the area (Para 58). Examiner analyzes this to mean the control unit 402 controls the timing of each illuminating unit 401 and control unit 406 controls the timing of detecting unit 405 to receive primarily light transmitted from a neighboring illumination unit 401.

(Final Office Action, pp. 2 and 3).

Appellant submits that nowhere in this analysis does the Office Action, and subsequently the Examiner's Answer, come close to identifying how or where Yukhin teaches or suggests the claimed light projector that projects three light projections of three different colors in sequence, i.e., one after another in time. There is no showing here that the cited prior art teaches or suggests the claimed light projector "for selectively illuminating an object, said light projector being configured to project three sequential light beam projections having different colors and different spatially varying intensity patterns from said projector onto said object." (Claim 32).

The Examiner's Answer also errs by suggesting that "Yukhin teaches the limitation "control unit 402 may also control spectral modulations". The "Examiner analyzes "spectral modulations" to be inherent to provide sequential red, blue, and green light per the control unit since this is a characteristic of light modulation such as LCD of display devices." (Examiner's Answer, p. 4). Again, this cannot be correct. Yukhin clearly teaches that electromagnetic radiation emitted from a light source comprises electromagnetic radiation from three different spectral ranges and, therefore, this cannot be an inherent property of "spectral modulations" as asserted by the Examiner.

Respectfully, to anticipate a claim, a reference must teach each and every element of the claim, and “the identical invention must be shown *in as complete detail as contained in the ... claim.*” MPEP 2131 citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1987) and *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913 (Fed. Cir. 1989) (emphasis added). Moreover, “[t]he prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements ‘arranged as in the claim.’” *NetMoneyIn v. Verisign*, (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542 (Fed. Cir. 1983)).

In the present case, Yukhin clearly does not disclose the claimed invention with each and every claimed element in the same amount of detail or as arranged in the claim. Consequently, because Yukhin clearly fails to satisfy the requirements for anticipating claim 32, the rejection of claim 32 and its dependent claims should not be sustained.

Claim 65:

Claim 65 recites:

A 3 D imaging camera comprising:
a light projector for selectively illuminating an object, said light projector being configured to project a number of *sequential* light beam projections having different wavelengths and different spatially varying intensity patterns from said projector onto said object; and
an image sensor configured to receive reflected light from said object and to generate a number of separate image data sets based on said number of sequential light beam projections, said separate image data sets providing said 3D image data of said object.

(Emphasis added).

As noted above, Yukhin never teaches or suggests the claimed light projector that projects the light beams sequentially, i.e., "said light projector being configured to project a number of *sequential* light beam projections having different wavelengths and different spatially varying intensity patterns from said projector onto said object." (Claim 65) (emphasis added). The Examiner's Answer fails on this point.

Respectfully, to anticipate a claim, a reference must teach each and every element of the claim, and "the identical invention must be shown in as complete detail as contained in the ... claim." MPEP 2131 citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1987) and *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913 (Fed. Cir. 1989) (emphasis added). Moreover, "[t]he prior art reference-in order to anticipate under 35 U.S.C. § 102-must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *NetMoneyln v. Verisign*, (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542 (Fed. Cir. 1983)).

In the present case, Yukhin clearly does not disclose the claimed invention with each and every claimed element in the same amount of detail or as arranged in the claim. Consequently, because Yukhin clearly fails to satisfy the requirements for anticipating claim 65, the rejection of claim 65 and its dependent claims should not be sustained.

Additionally, various dependent claims of the application recite subject matter that is further patentable over the cited prior art. Specific, non-exclusive examples follow.

Claim 34:

Claim 34 recites "wherein said plurality of CCD sensors comprises 3 CCD monochromatic sensors." However, as demonstrated above, Yukhin teaches light sources operating in three different spectral ranges, i.e., ultraviolet, visible and infrared. This clearly teaches away from the claimed "3 CCD monochromatic sensors" of claim 34. For at least this additional reason, the rejection of claim 34 should not be sustained.

Claim 35:

Claim 35 recites: "[t]he high speed 3D surface imaging camera of claim 32, further comprising a computing device communicatively coupled to said image sensor wherein said computing device is ***configured to combine said separate color image data sets into a composite Rainbow-type image of said object.*** (Emphasis added). In this regard, the Examiner's Answer cites to Yukhin at paragraphs 0075. (Examiner's Answer, p. 17). Indeed, the following paragraphs describe the processing of data from a number of photo registrars.

[0074] As shown in FIG. 6, digital image data from each of the one or more photoregistrars is passed to at least one signal processor 660A-660N. Each signal processor 660A-660N recognizes and processes one version of distorted patterns, such as an aperiodic system of strips. The coding sequence for the pattern of structured illumination may depend on the pattern projected by SLM devices 515A-515N of FIG. 5. For instance, in a system utilizing aperiodic strips, a "1" may be generated when a line is present, and when a line is absent, a

"0" may be produced. The output of this exemplary coding sequence is shown in FIGS. 7a and 7b. Consistent with the present invention, the system may, however, utilize other patterns or types of structured light, such as a grid pattern. In addition, other coding schemes for coding the distorted patterns may be utilized.

[0075] The resultant processed digital signal such as reconstructed 3D topology from signal processors 660A-660N may be accumulated in electronic unit 690. For example, processor 670 of electronic unit 690 may sum the signals received from each of signal processors 660A-660N to create an "**overall**" digital image. In addition to summarizing the binary signals, processor 670 may determine the coordinates values (X, Y) of the object's surface. As a result, each line (or strip) in the "**overall**" digital image may have a unique number in binary code. Based on the summarized codes, processor 670 can then calculate the distance, Z, and corresponding pairs of coordinates because distances between the strips forming structural illumination differ on the registered picture. (Yukhin, paragraphs 0074-0075) (emphasis added).

Appellant notes that the result described is an "overall" digital image. However, Yukhin never teaches or suggests the claimed "combin[ation of] said separate **color** image data sets into a **composite Rainbow-type image** of said object." (Claim 35) (emphasis added). Indeed, contrary to what the Examiner's Answer purports and in line with the arguments above in connection with claim 32, nowhere in Yukhin is it taught or suggested that **color** images are combined to form a composite Rainbow-type image. Therefore, for at least this additional reason, the rejection of claim 35 should not be sustained.

Claim 61:

Claim 61 recites "a computing device communicatively coupled to said image sensor, wherein said computing device further comprises a mosaic means configured to combine said three separate color image data sets to form a multi-view 3D image of said object." As cited above in connection with claim 35, Yukhin does not teach or suggest mosaic means combining

three separate *color* image data sets to form a 3D image of an object. Rather, Yukhin works on entirely different principles. For at least this additional reason, the rejection of claim 61 should not be sustained.

Claim 62:

Claim 62 recites "wherein each of said 3 CCD monochromatic sensors comprise a matched narrow-band spectral filter disposed in front of said CCD sensor." According to the Examiner's Answer, this subject matter is taught by Yukhin in the form of a "beam splitter 615." (Examiner's Answer, p. 18). This is clearly incorrect.

Claim 62 recites three separate narrow-band spectral filters respectively disposed in front of three CCD monochromatic sensors. A beam splitter is not a narrow-band spectral filter. A single beam splitter is not *three* separate narrow-band spectral filters, as claimed. Indeed contrary to what the Examiner has suggested, nowhere in Yukhin is it taught or suggested that the beam splitter is dichroic and that the beam splitter splits the light into *three* different beams. (See Examiner's Answer, p. 18). For at least this additional reason, the rejection of claim 62 should not be sustained.

(2) Claim 73 is patentable over Yukhin and Hasegawa:

Claim 73 recites: "The 3D imaging camera of claim 65, wherein said light projector is configured to project three sequential light beam projections each of a different color within the visible spectrum." The final Office Action had conceded that "Yukhin does not specifically

teach light beam projections each of a different color within the visible spectrum." (Final Office Action of January 27, 2010, p. 15).

Accordingly, the Examiner must rely on Hasegawa. As Appellant has noted previously on this record, Hasegawa teaches "an image pickup system with an illuminating device capable of sequentially irradiating three kinds of color lights different from each other onto an object, an objective lens system forming images of the object with the color lights, a solid-state image sensor receiving the images of the object, a signal processing device producing individual color images of the object based on the solid-state image sensor, and a color dispersion device or a color separation device disposed in an optical path of light incident on the solid-state image sensor from the object." (Hasegawa, Abstract). Hasegawa further teaches that "image signals corresponding to the respective colors ... are integrated together . . . to thereby be displayed in color on a screen of a color TV monitor 23." (Id, col. 4, line 67 to col. 5, line 9). In other words, Hasegawa exclusively teaches a method of producing a 2D image.

Again, according to the final Office Action,

Hasegawa shows in figure 4 the filter disc (8) is constructed in such a way that filters 8a, 8b and 8c having such spectral transmittances as will transmit there through only R light, only G light and only B light, respectively, are arranged at an equal interval from each other on a same circumference (Col. 5, line 65 - Col. 6, line 13). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided filter disk as taught by Hasegawa to the illuminating unit of Yukhin, to provide an image pickup device which eliminates degradation of the integrated color image brought about by chromatic aberration of the images for the respective colors (Col. 1, lines 65 - 68 of Hasegawa).
(Final Office Action, p. 15).

This position raises significant questions. First, why would one skilled in the art apply the teachings of Hasegawa for producing 2D images to the teachings of Yukhin? Second,

Yukhin clearly teaches using radiation from different spectra, i.e., ultraviolet, infrared, etc. Why would one of skill in the art modify these teachings to include the color filters taught by Hasegawa?

In a recent decision, the Board of Patent Appeals and Interferences stated the following:

The Examiner's articulated reasoning . . . in the rejection must possess a rational underpinning to support the legal conclusion of obviousness. *In re Kahn*, 441 F.3d 977,988 (Fed. Cir. 2006). The Supreme Court, reiterating this reasoning by citing *In re Kahn*, 441 F.3d at 988, stating that 'rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.' *KSR* at 412.

(*Ex Parte Val Mandrusou*, Application Serial No. 101235,221,2008 WL 2845083 (B.P.A.I. 2008)).

Given this, it would seem clear that the rejection of claim 73 is based on a mere conclusory statement, cited above, with no rational underpinning supporting the legal conclusion of obviousness. There is no reason to conclude that one of skill in the art would not have found it obvious to combine the disparate teachings of Yukhin and Hasegawa in a manner approximating Appellant's disclosure and claims. For at least these reasons, no prima facie case of obviousness has been made as to claim 73, and thus the rejection of claim 73 should not be sustained.

In view of the foregoing, it is submitted that the final rejection of the pending claims is improper and should not be sustained. Therefore, a reversal of the Rejection of **January 27, 2010** is respectfully requested.

Respectfully submitted,

/Steven L. Nichols/

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